Hurricane Presentation 2014

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Hurricane Presentation 2014

- Basic Hurricane Information - Development
- Seasonal Areas of Development
- Hurricane Definitions – Confusion at It's Finest
- Inter Tropical Convergence Zone – ITCZ
- Saffir-Simpson Scale/El Nino – Myth or Fact
- The Need for Improvement
- Hurricane Damage Potential - Something Better
- Landfall Forecast – 2014

Basic Hurricane Information - Development

- The atmosphere is composed of fluid; i.e. water vapor.
- Hurricanes are nothing but highly compressed and charged amounts of water vapor.
- Everyone wants to turn hurricanes into statistics, but like each snowflake, no 2 hurricanes are exactly alike.
- People and property don't the know difference between 110 mph versus 111 mph (Category 2 vs. Category 3).
- We have other Federally and global recognized criteria that are totally ignored when dealing with hurricanes.
- (Beaufort Wind Scale, NWS High Wind Warnings).

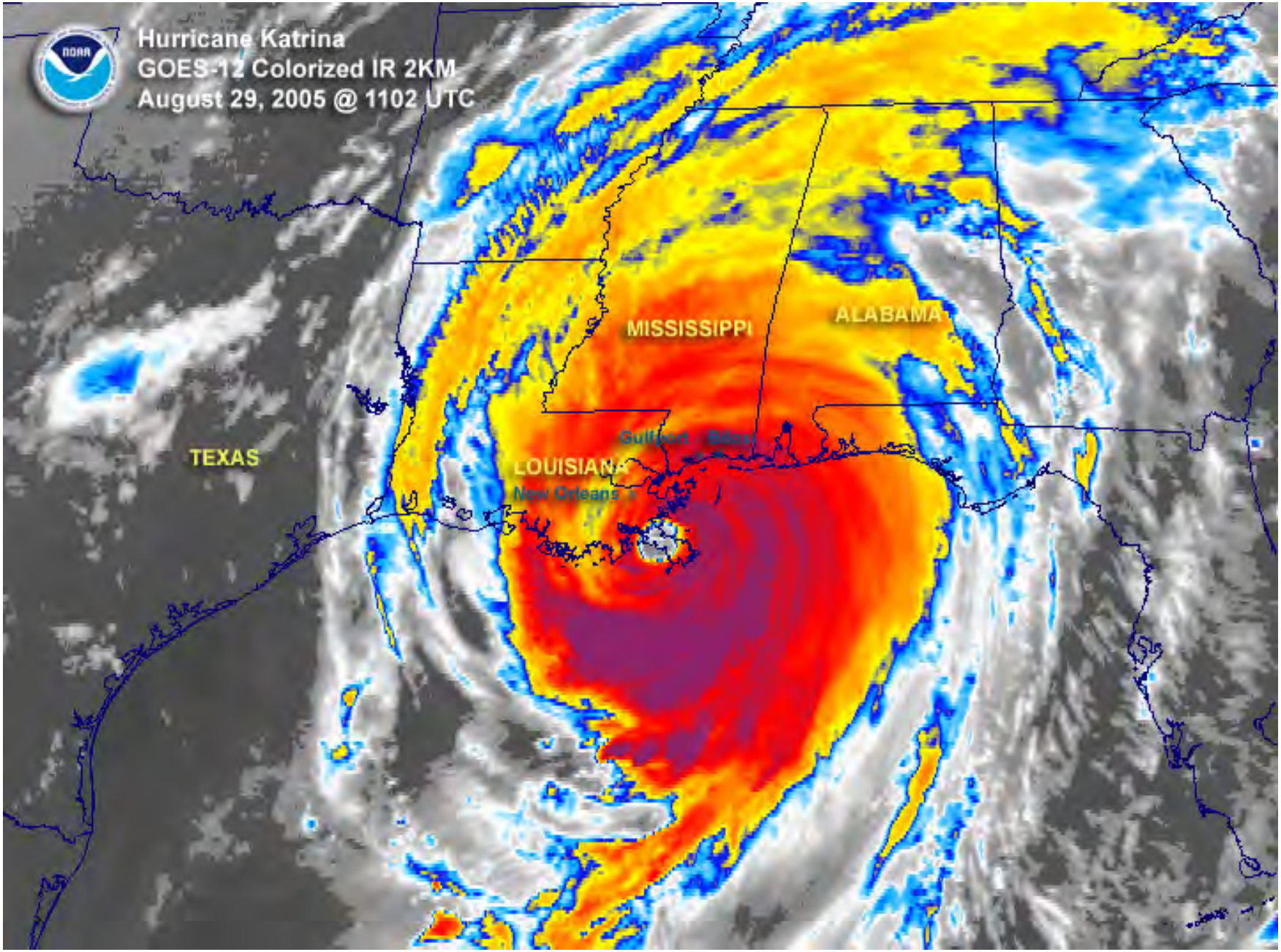
Basic Hurricane Information - Development

1. **Tropical disturbance** - first stage of development of a hurricane. It consists of a mass of thunderstorms that have only a slight wind circulation.

2. **Tropical Depression (TD)** – Sustained winds near the center of the tropical depression are constantly between 20 and 34 knots (23 - 39 mph). Lowered pressure is indicated with at least one closed isobar on a surface pressure chart. Also, the organized circulation of wind in the center of the thunderstorms is detected.

3. **Tropical Storm (TS)** – receives name from National Hurricane Center (NHC) Sustained winds are a minimum of 39 mph to 73 mph. Slow development leads to heavy rainfall.

4. **Hurricane** – strong center rotation, sustained winds minimum of 74 mph for **1 minute**.


Hurricane Katrina
GOES-12 Colorized IR 2KM
August 29, 2005 @ 1102 UTC
MISSISSIPPI
ALABAMA
TEXAS
LOUISIANA
Gulfport
Biloxi
New Orleans

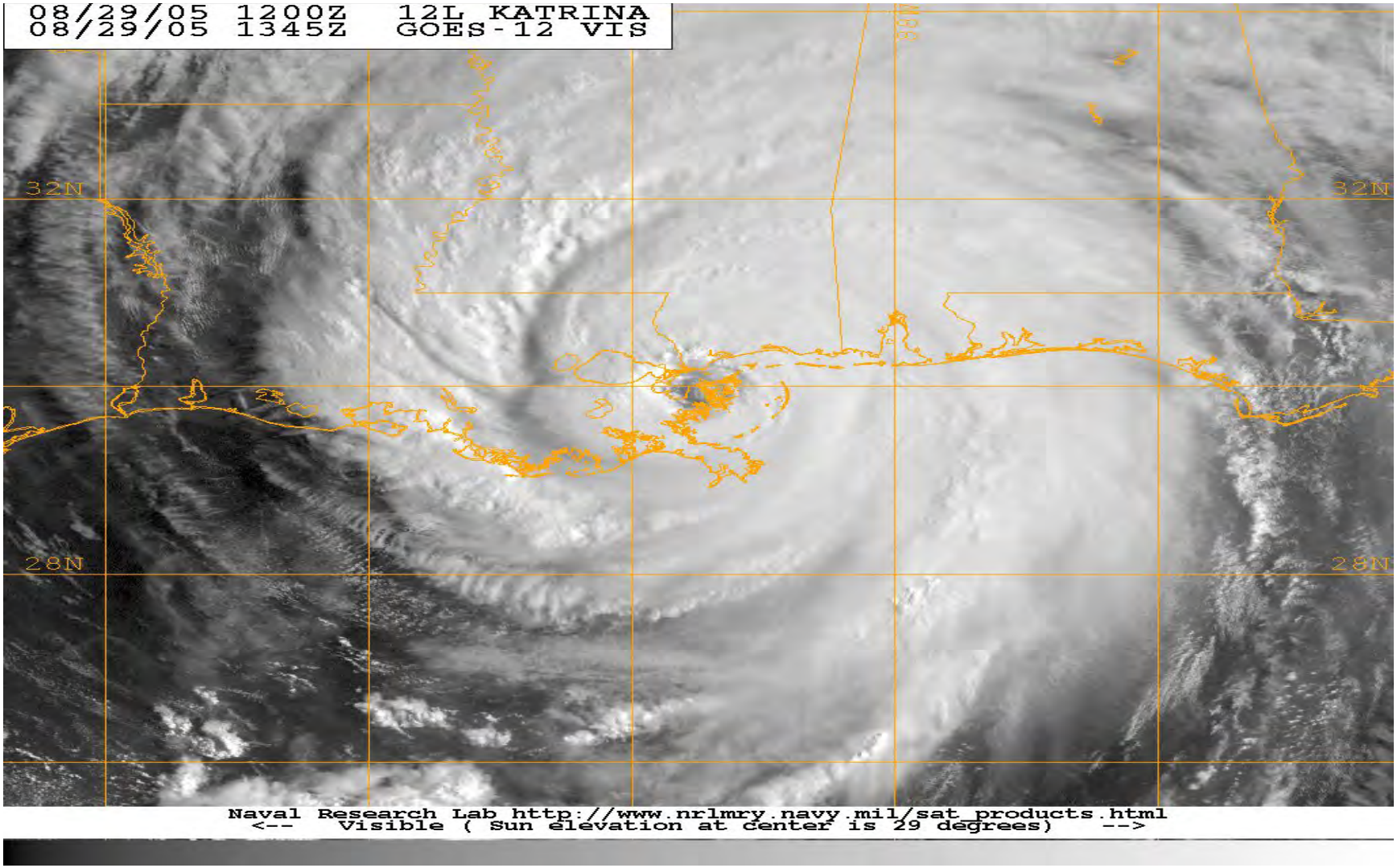
Basic Hurricane Information - Development

- Usual open water temperatures vary between 75 to 80 degrees before enough energy to influence hurricane formation.
- Water temperature is not the only factor that drives formation. Without upper level support, storms will not develop. Strong outflow aloft necessary for tropical cyclone development.
- Highest winds contained between 300 feet to 2500 feet above the ground. This wind layer is “pushed” to the ground, in the form of gusts, due to collapsing thunderstorms.
- A puzzle has many parts, so does hurricane development. Too much dry air, no storms, too much water temperature variation, no storms. A tricky combination is necessary.

Basic Hurricane Information - Development

- Double Eyewalls and Hurricane Katrina
- Conventional single eyewall hurricanes generally have their strongest winds within 25 miles of the storm center. Severe wind damage may occur over a coastal strip up to 50 miles wide.
- Double eyewall hurricanes may inflict severe wind damage over a much broader coastal strip. These hurricanes have an outer eyewall that can spread some of their strongest winds over a path up to 100 miles wide.
- Approximately 70% of the Atlantic and 50% of the East Pacific intense storms reached concentric or double eyewall status between 1997 and 2005.
- http://www.southalabama.edu/publicrelations/pressreleases/2007pr/blackwellresearchpaper.pdf

Basic Hurricane Information - Development



Basic Hurricane Information - Development

- The hurricane's highest reported surface gust was 135 mph, in Poplarville, Mississippi; many weather stations were destroyed, so Katrina's highest gusts were not measured.

- Video evidence from storm chasers suggests gusts on the ground in Gulfport, MS, could have been as high as 150 mph.

- Winds from the outer eyewall hit the Mississippi coast up to 4 hours before the storm surge reached its peak during the landfall of the inner eyewall.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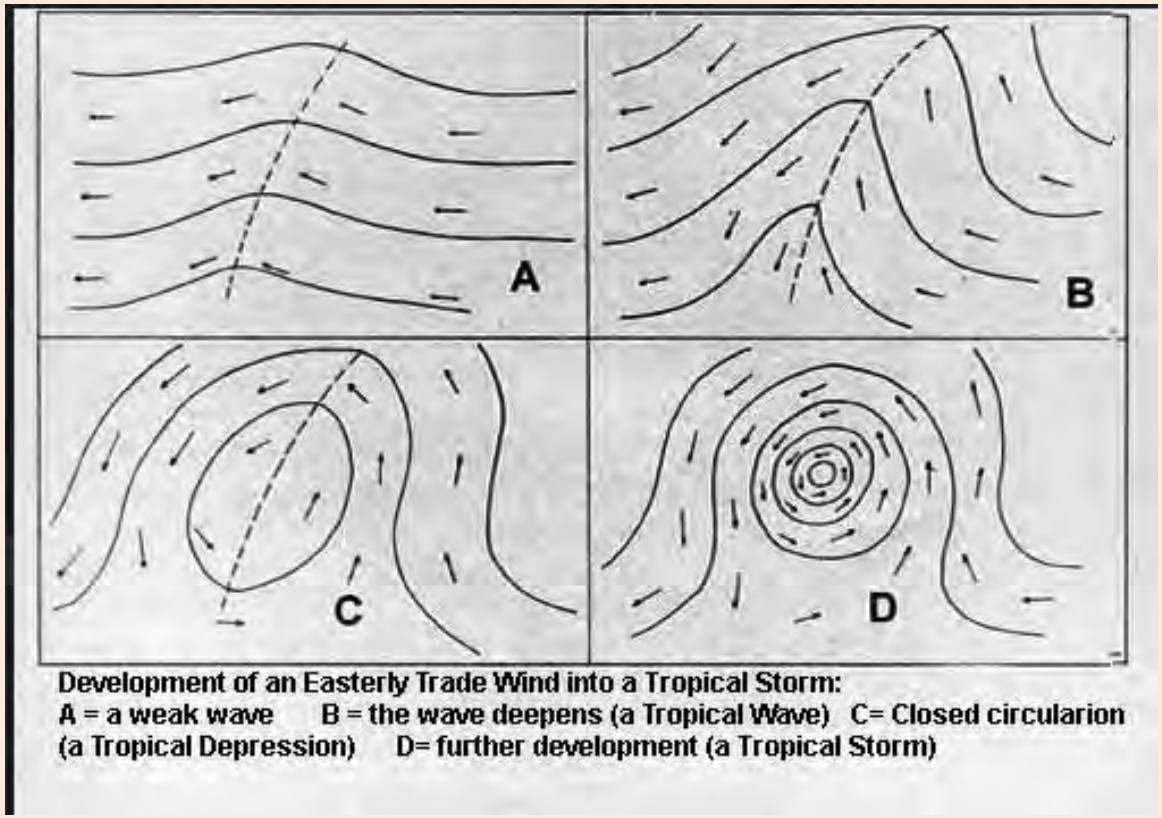
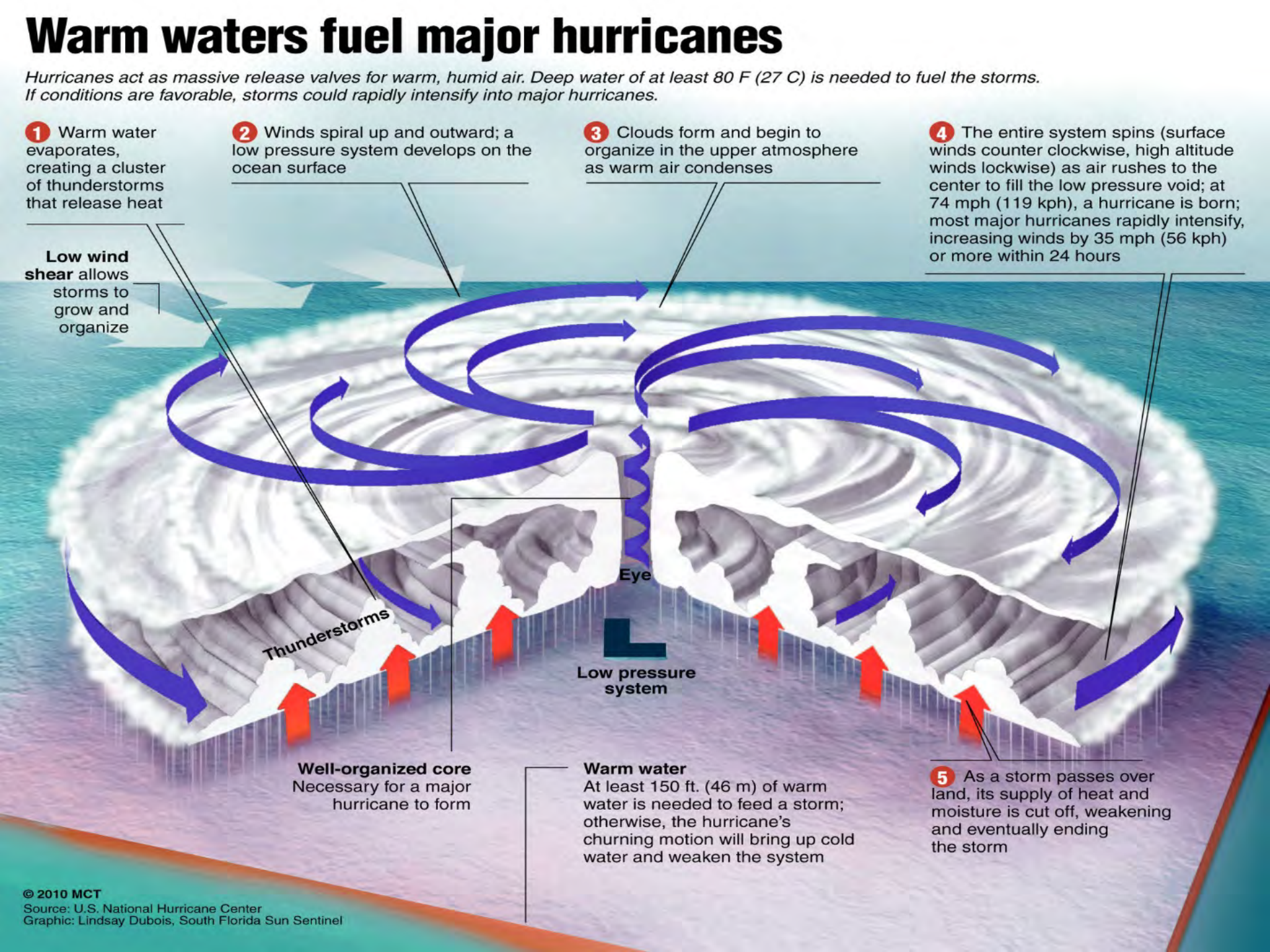
Hurricane Formation



Development of an Easterly Trade Wind into a Tropical Storm:
A = a weak wave B = the wave deepens (a Tropical Wave) C= Closed circularion (a Tropical Depression) D= further development (a Tropical Storm)

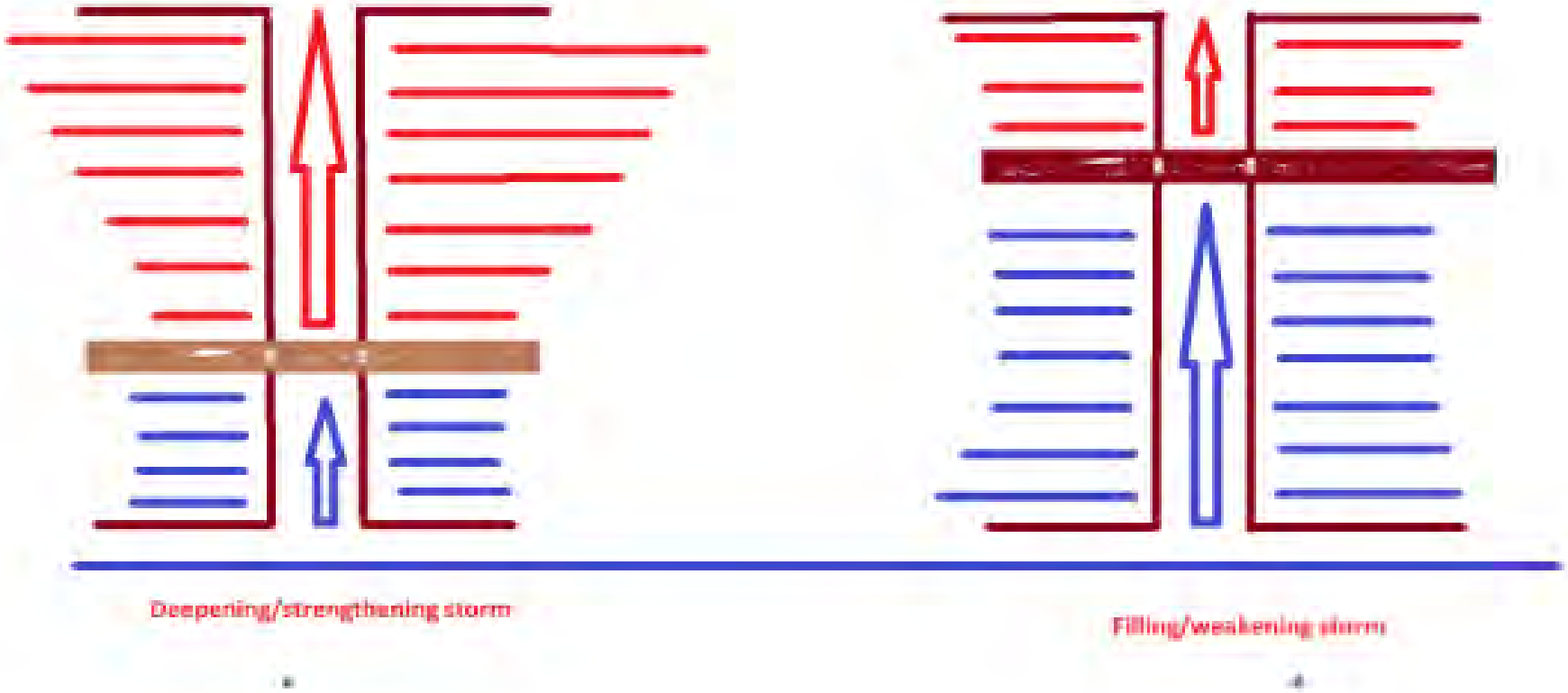
Warm waters fuel major hurricanes

Hurricanes act as massive release valves for warm, humid air. Deep water of at least 80 F (27 C) is needed to fuel the storms. If conditions are favorable, storms could rapidly intensify into major hurricanes.

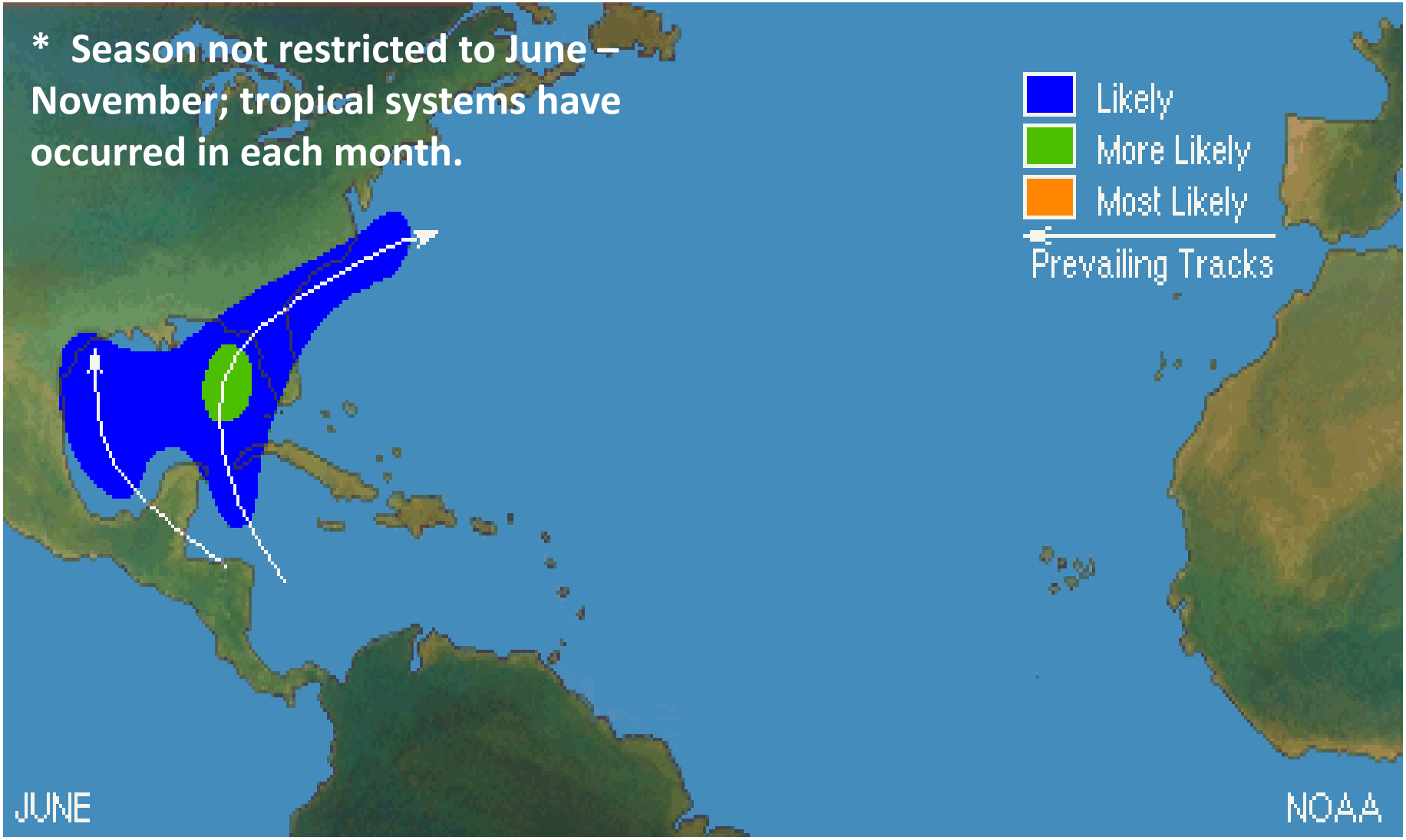


Source: U.S. National Hurricane Center
Graphic: Lindsay Dubois, South Florida Sun Sentinel

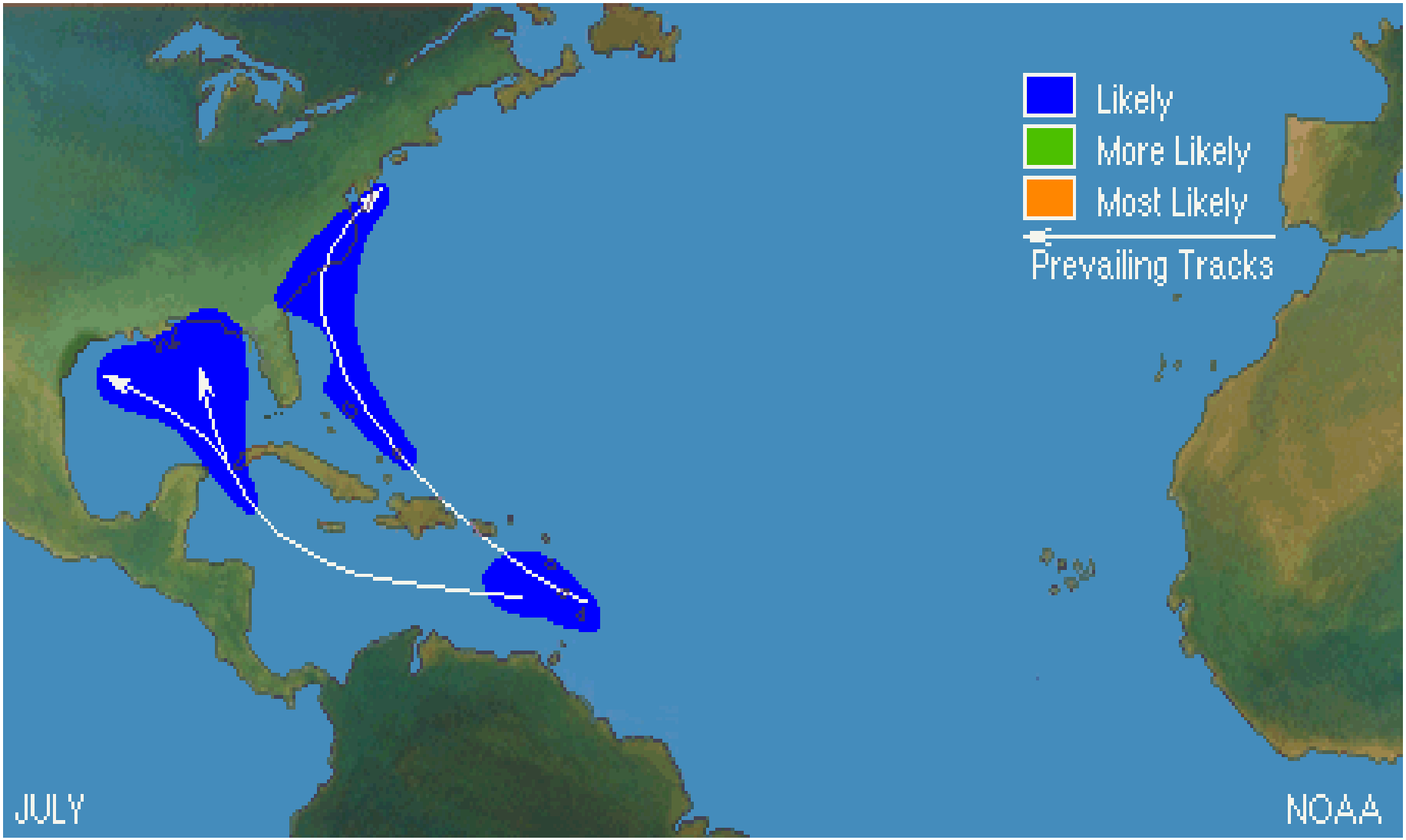
Strengthening/Weakening Storm



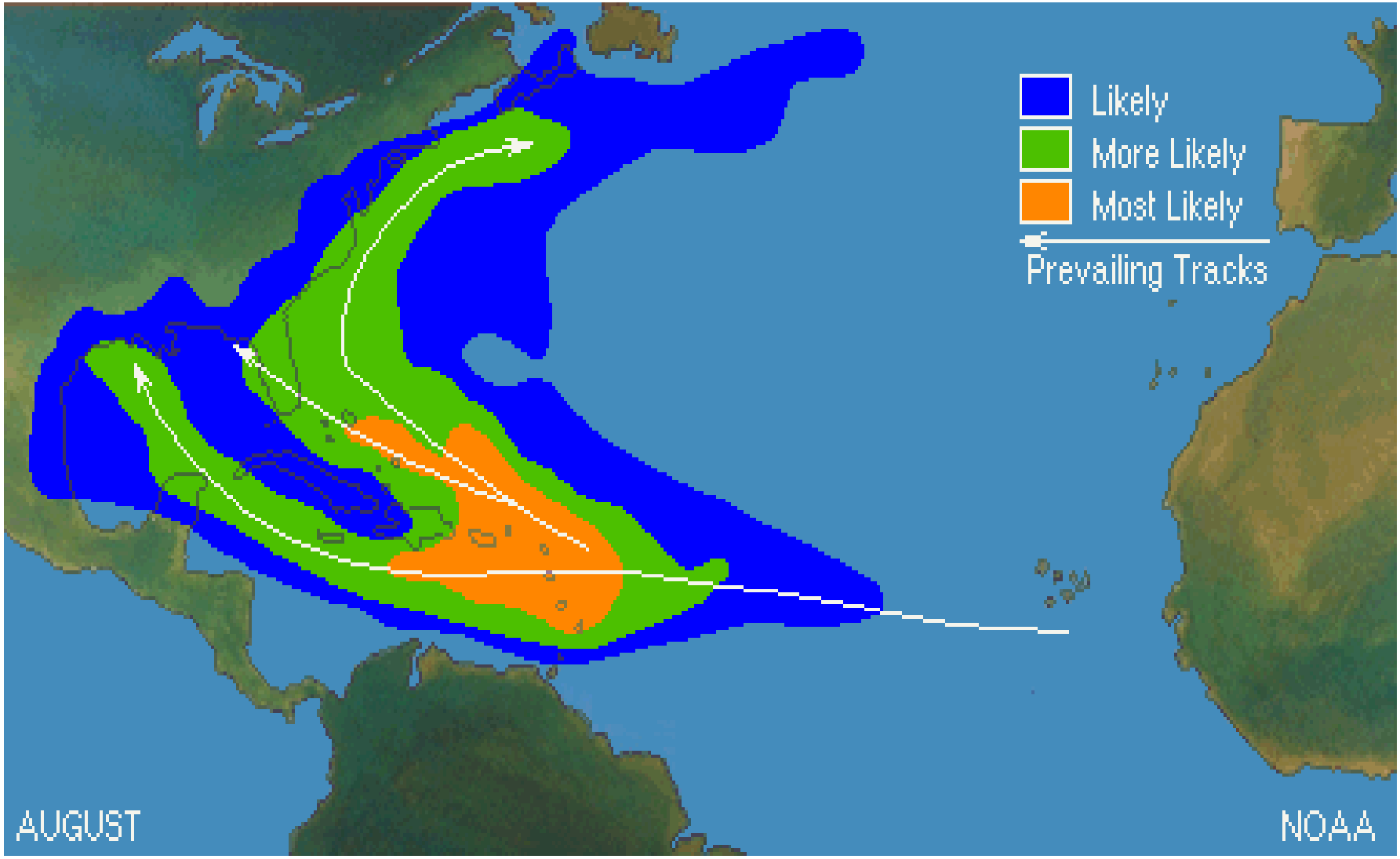
Seasonal Areas of Development



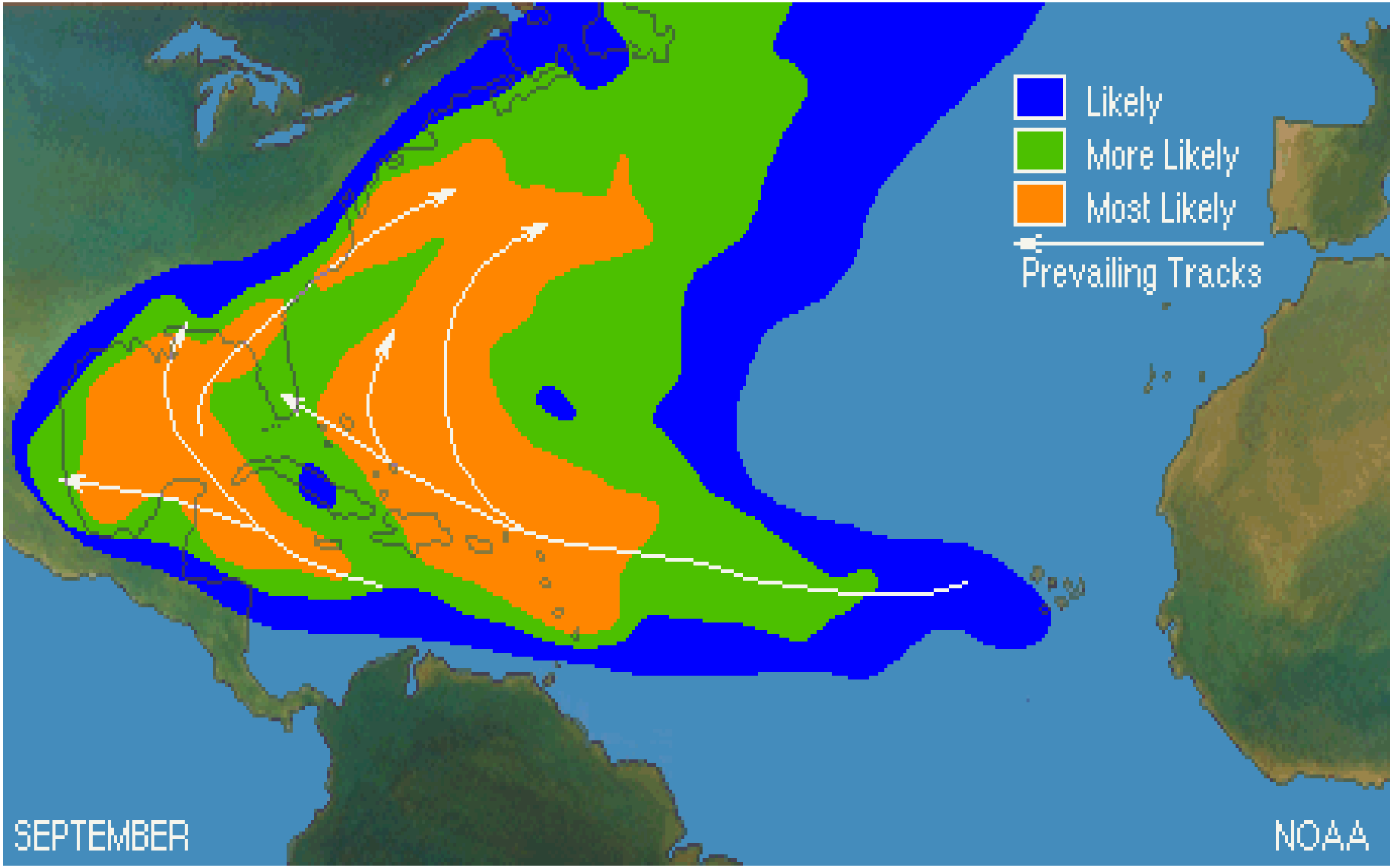
Seasonal Areas of Development



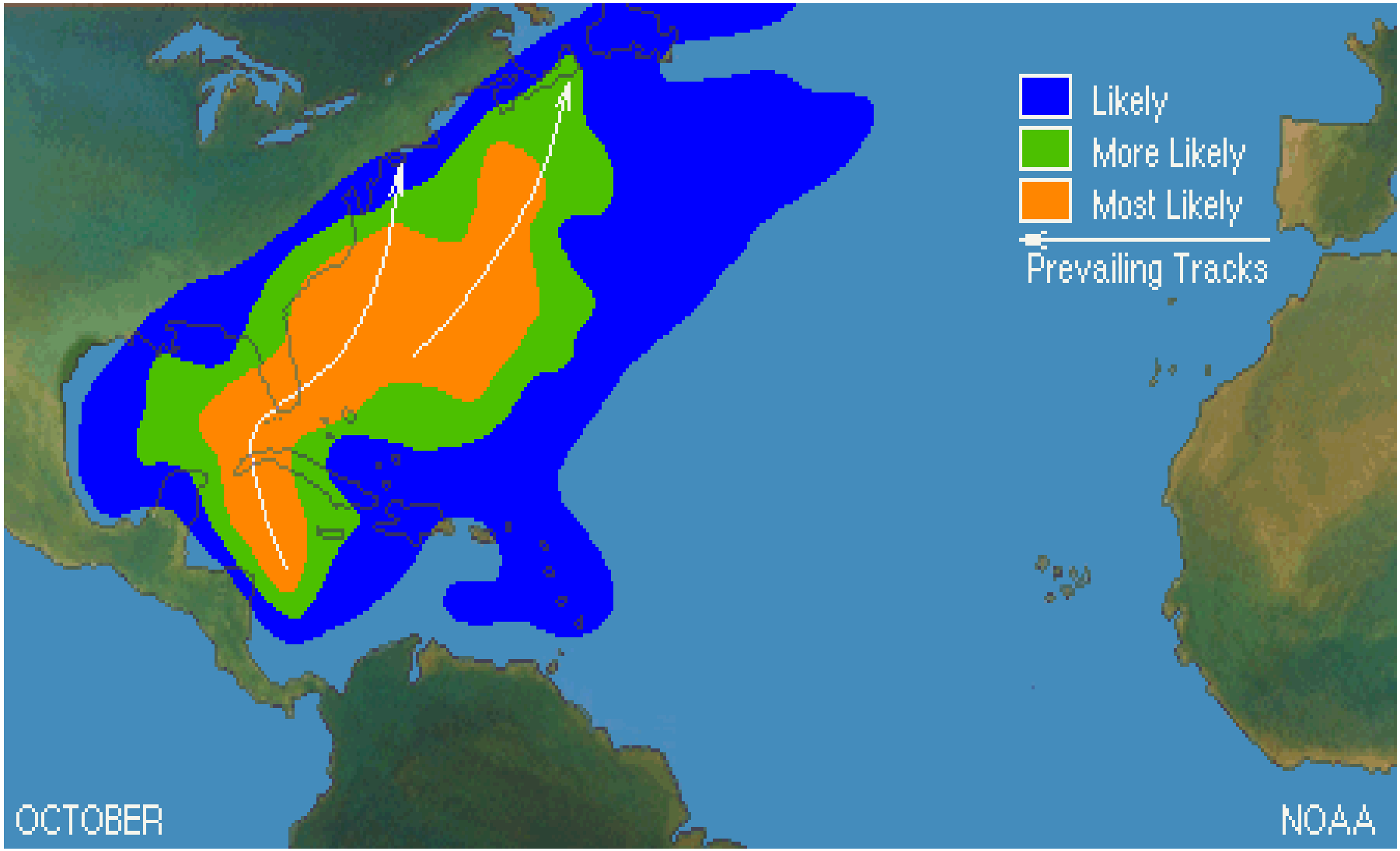
Seasonal Areas of Development



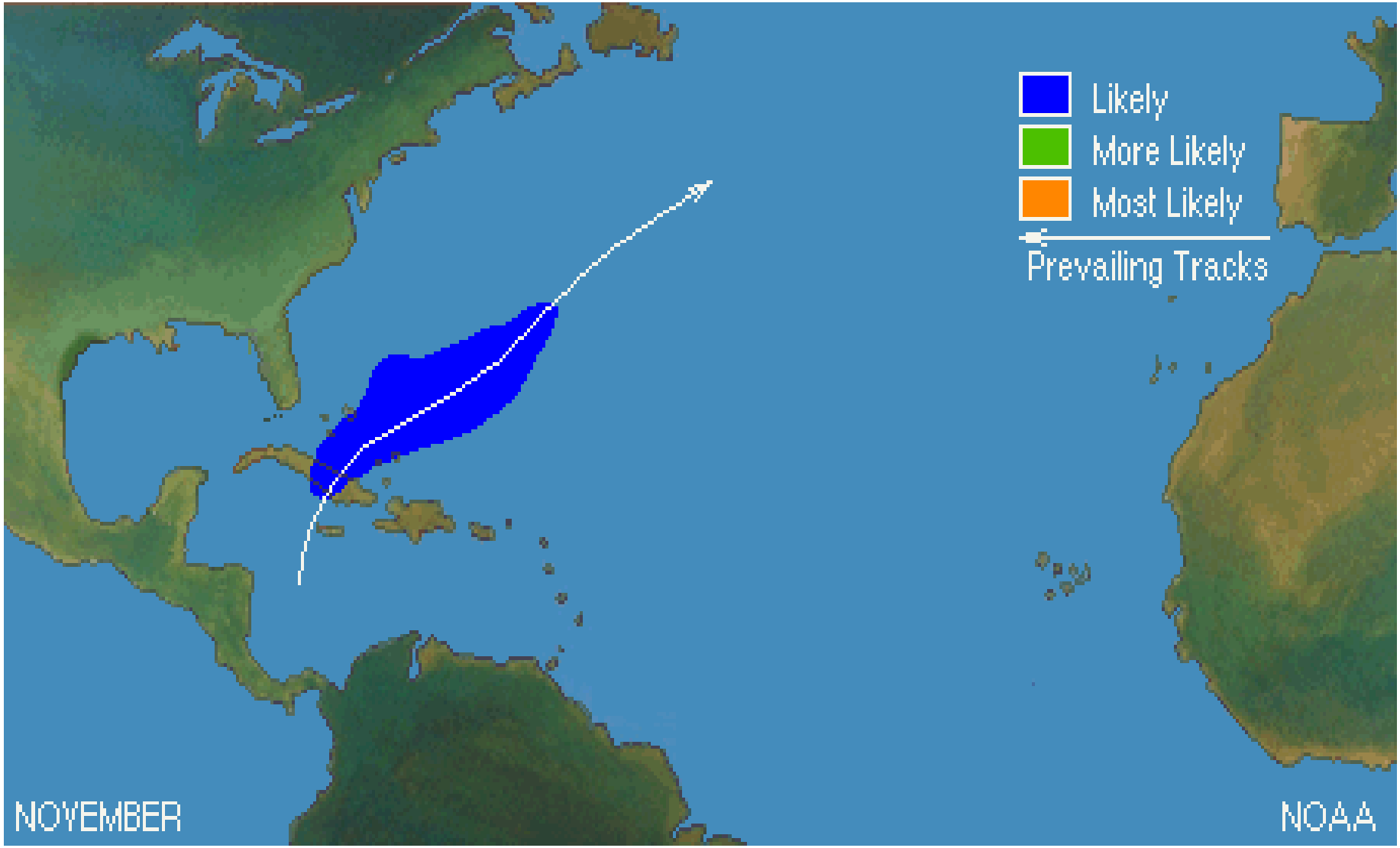
Seasonal Areas of Development



Seasonal Areas of Development



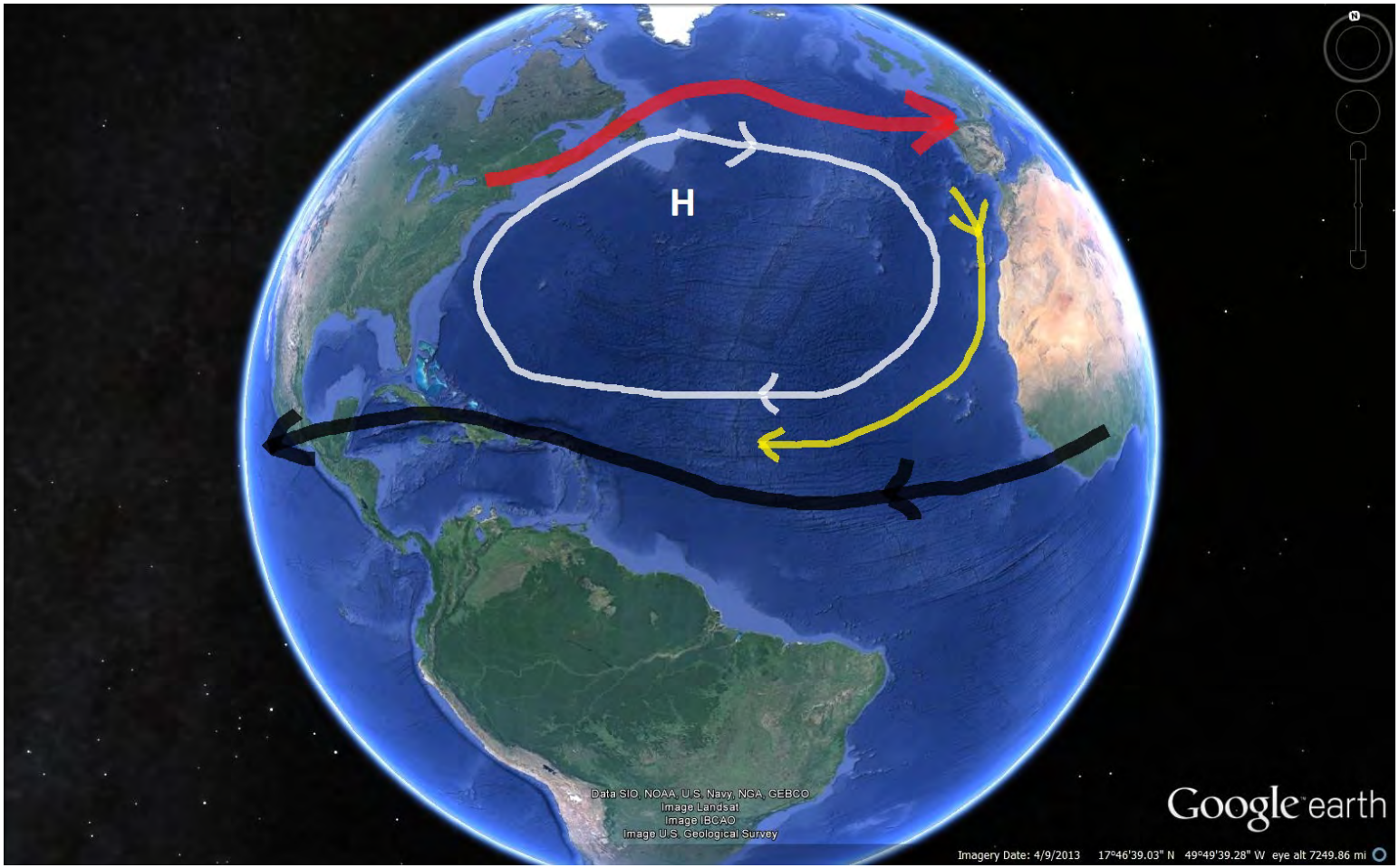
Seasonal Areas of Development



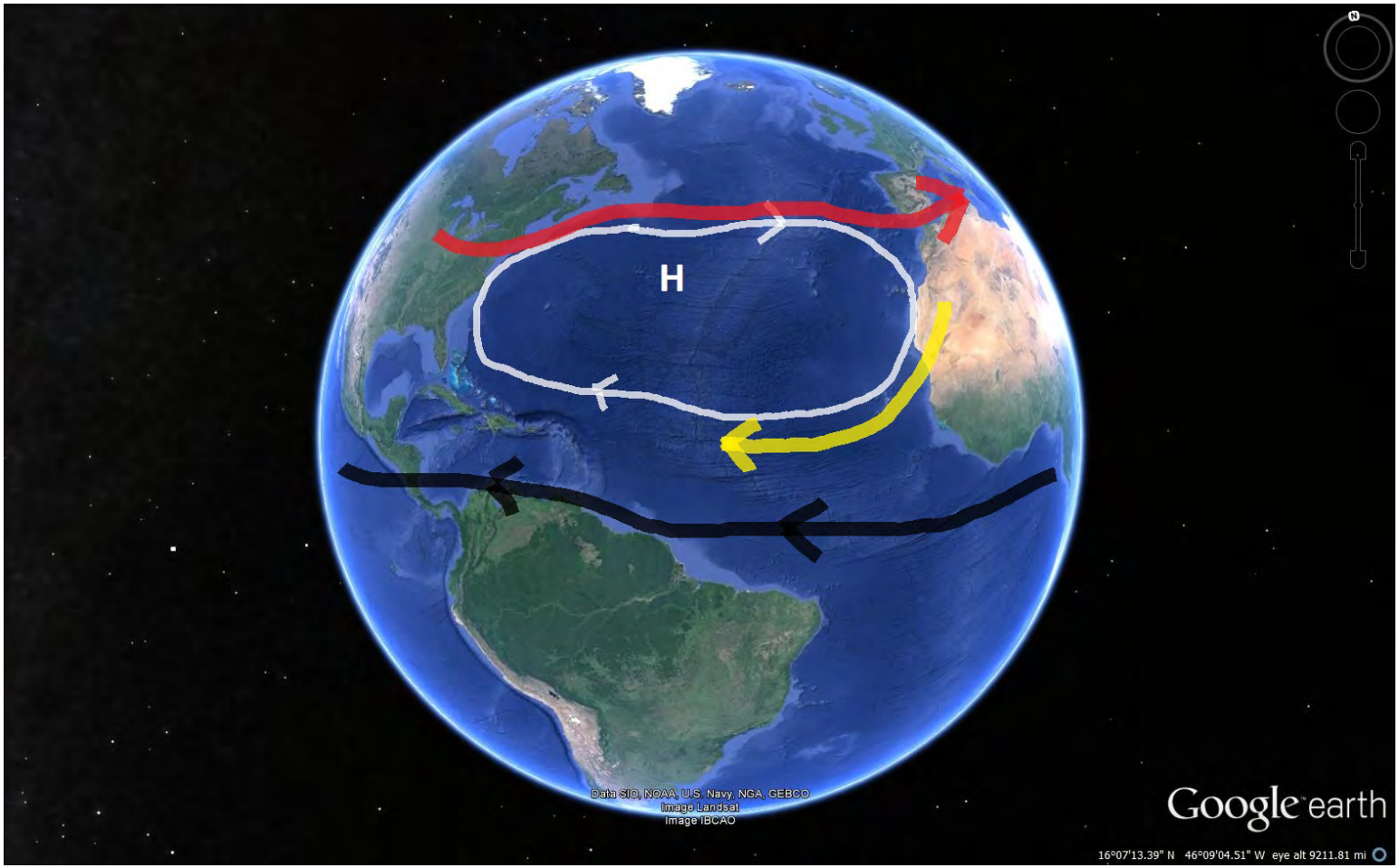
Inter Tropical Convergence Zone – ITCZ

- A band of winds around the Equator, containing warmer temperatures, warmer sea temperatures and strong convection.
- Normally the ITCZ is centered around the Equator (0 degrees latitude), but can vary by 3 to 4 degrees.
- In summer, the ITCZ migrates northward, bringing the additional energy (warmer air and water) towards higher latitudes.
- Over the years, I found that when the ITCZ reaches 12 degrees North latitude, the United States is exposed to strong African tropical waves. It is the African waves that usually result in the most dangerous hurricanes for the United States.
- ITCZ is the area where the “trade winds” of the northern and southern hemisphere “converge” near the Equator. An area of more “concentrated” energy.
- The summer “resting spot” of the Bermuda High determines the northern extent and strength of the ITCZ during hurricane season.
- In 2013, Bermuda High was located in an area that did not permit ITCZ to move northward as expected. The location of Bermuda High also resulted in huge clouds of Sahara dust to move across Atlantic, prohibiting formation of tropical systems.

Inter Tropical Convergence Zone – ITCZ Seasonal Average Positions

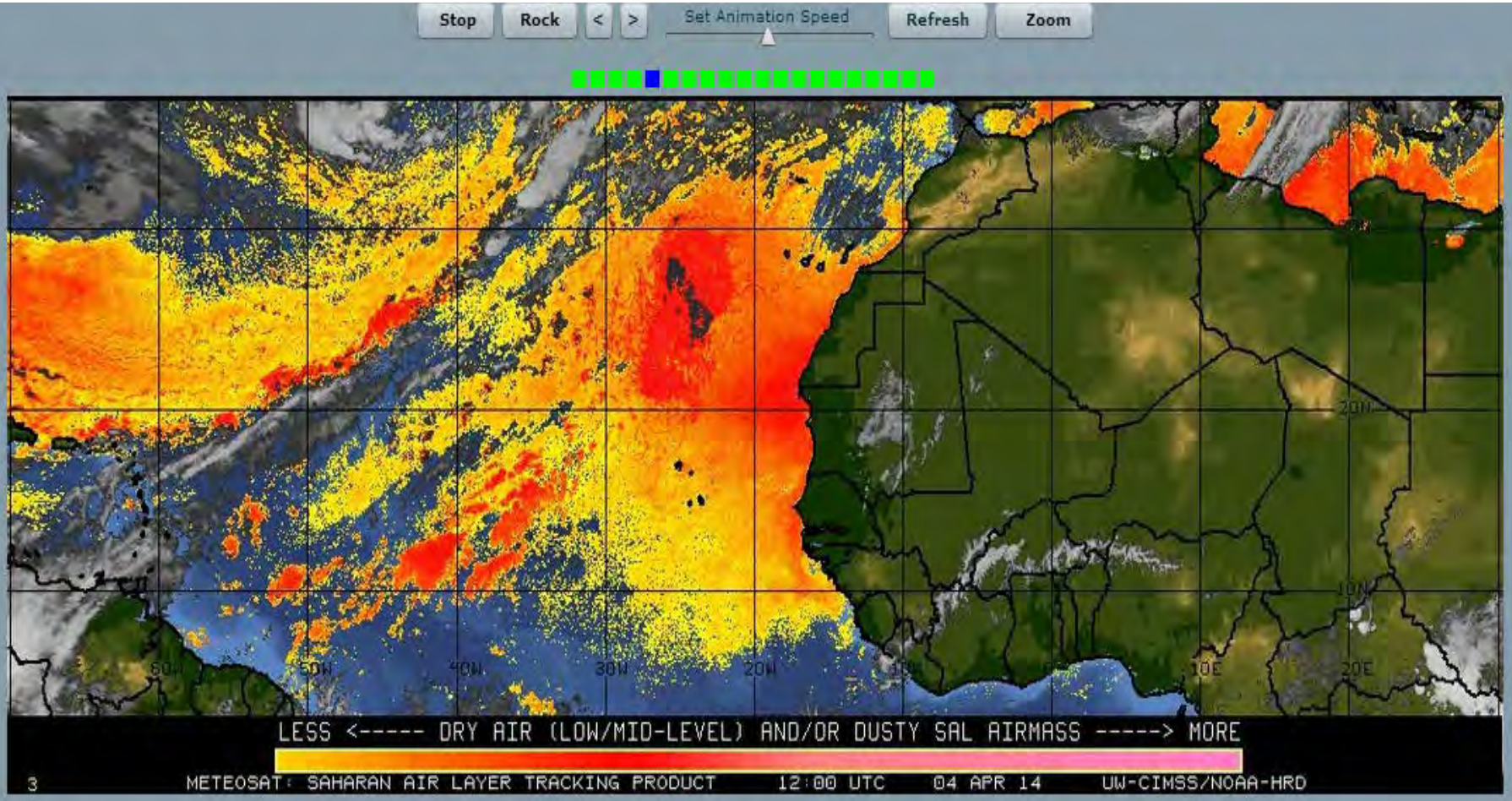


Inter Tropical Convergence Zone – ITCZ Summer 2013



Inter Tropical Convergence Zone – ITCZ

- **Sahara Sands**



Saffir-Simpson Scale/El Nino – Myth or Fact

* **No firm definition for El Nino.**

  AMS – 0.5 degree © increase for a period of at least 4 months, and expected to last a minimum of 6 months.

  NWS – 0.5 degree © increase for period of 3 months, based upon average water temperatures between 1971 – 2000.

  ESR – 3 – 6 degree © increase for 3 months, based upon average water temperatures between 1990-2010.

* **Most hurricane projections based on continually changing factors. After each year of "inaccurate" forecasts, climatologists go back to see what was missed. Usual results are discovery of new meteorological features unknown or dismissed before.**

Saffir-Simpson Scale/El Nino – Myth or Fact

Saffir-Simpson Hurricane Scale

Scale Number (Category)	Sustained Winds (MPH)	Types of Damage
1	74-95	**Minimal:** *Damage primarily to shrubbery, trees, foliage and unanchored mobile homes. No real damage to other structures.*
2	96-110	**Moderate:** *Some trees blown down. Major damage to exposed mobile homes. Some damage to roofing materials, windows and doors.*
3	111-130	**Extensive:** *Large trees blown down. Mobile homes destroyed. Some structural damage to roofing materials of buildings. Some structural damage to small buildings.*
4	131-155	**Extreme:** *Trees blown down. Complete destruction of mobile homes. Extensive damage to roofing materials, windows and doors. Complete failure of roofs on many small residences.*
5	>155	**Catastrophic:** *Complete failure of roofs on many residences and industrial buildings. Extensive damage to windows and doors. Some complete building failure.*

NOTE: Damage can vary greatly and may not apply to all areas, such as Hawaii.

Saffir-Simpson Scale/El Nino – Myth or Fact (NWS)

Saffir-Simpson Hurricane Wind Scale for the Continental United States

Scale Number (Category)	Sustained Winds (MPH)	Types of Damage Due to Hurricane Winds	Hurricanes
1	74-95	**Very dangerous winds will produce some damage:** *Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.*	***Dolly (2008) on South Padre Island, Texas***
2	96-110	**Extremely dangerous winds will cause extensive damage:** *Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.*	***Frances (2004) in coastal Port St. Lucie, Florida***
3	111-129	**Devastating damage will occur:** *Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.*	***Ivan (2004) in coastal Gulf Shores, Alabama***
4	130-156	**Catastrophic damage will occur:** *Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.*	***Charley (2004) in coastal Punta Gorda, Florida***
5	157 or higher	**Catastrophic damage will occur:** *A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.*	***Andrew (1992) in coastal parts of Cutler Ridge, Florida***

Saffir-Simpson Scale/El Nino – Myth or Fact

Category	One					Two			Three			Four						Five						
Wind Speed (mph)	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190
Multiplier	1x	1.6x	2.9x	4.3x	6.6x	10x	15x	21x	30x	43x	60x	82x	110x	147x	195x	256x	333x	429x	549x	697x	879x	1101x	1371x	1696x

These values indicate increases in damage potential **ABOVE** damage that occurs with a 75 mph hurricane.

R. A. Pielke, Jr. and colleagues. "Normalized Hurricane Damage in the United States: 1900–2005" Natural Hazard Review (2008)

Saffir-Simpson Scale – Myth or Fact

- The "accepted and established" method of categorizing expected hurricane damage. First issued in 1969 by Dr. Hebert Saffir and Dr. Robert Simpson to categorize hurricane damages by NHC. It was not made public.

- The Saffir-Simpson Scale has never been verified because there is no objectivity on how to quantify damages.

- In 1991, Dr. Simpson did a radio interview with Ms. Debi Iacovelli, tropical storm specialist in Cape Coral Florida. In that interview:

  1. Dr. Simpson stated that *" it was a little bit premature to put the scale out without improving it a bit."*

  2. Dr. Simpson also stated that *"at the time, pressure was placed on Dr. Neil Frank, (then Director, NHC) to issue something to the public".*

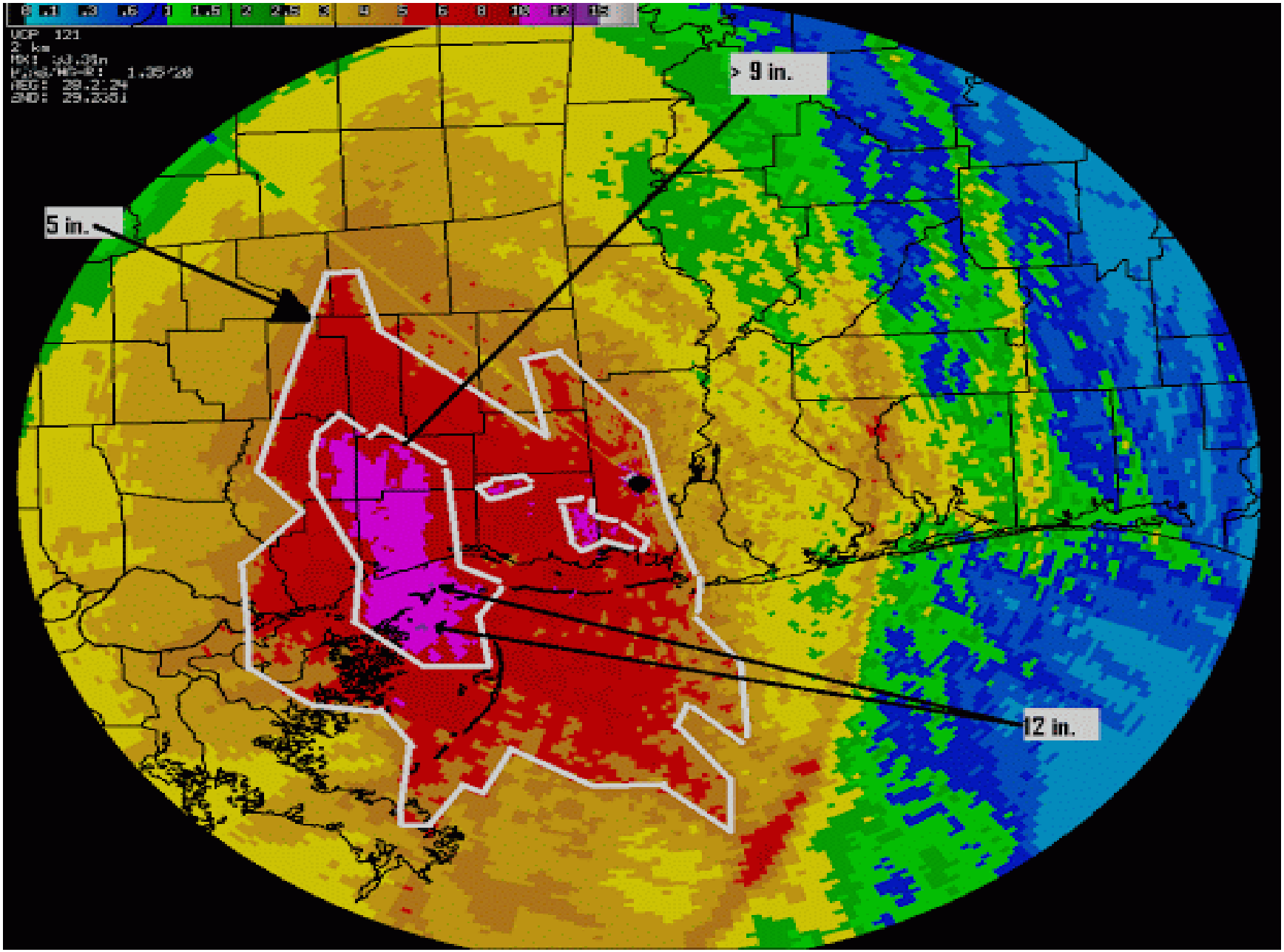
Saffir-Simpson Scale – Myth or Fact

3. Dr. Simpson goes on to say *"politics and the situation was such that when people want something, they are going to get it, whether they know how to use it or not."*

4. Lastly, Dr. Simpson said *"it's been mis-interpreted and mis-used in a lot of places.*

Initially had levels of storm surges for each category, but none of the real-time data supported this "expectation", so storm surge levels were dropped.

There is no standardization among various agencies what each category is expected to do, but it's what we are used to and want to know for pending storms, but what does it really mean?


> 9 in.
5 in.
12 in.

The Need for Improvement

- As we learn more, our methods of classification, damage assessment and analysis of embedded features must change, but we are still using methodologies and expectations from 1969 and earlier.

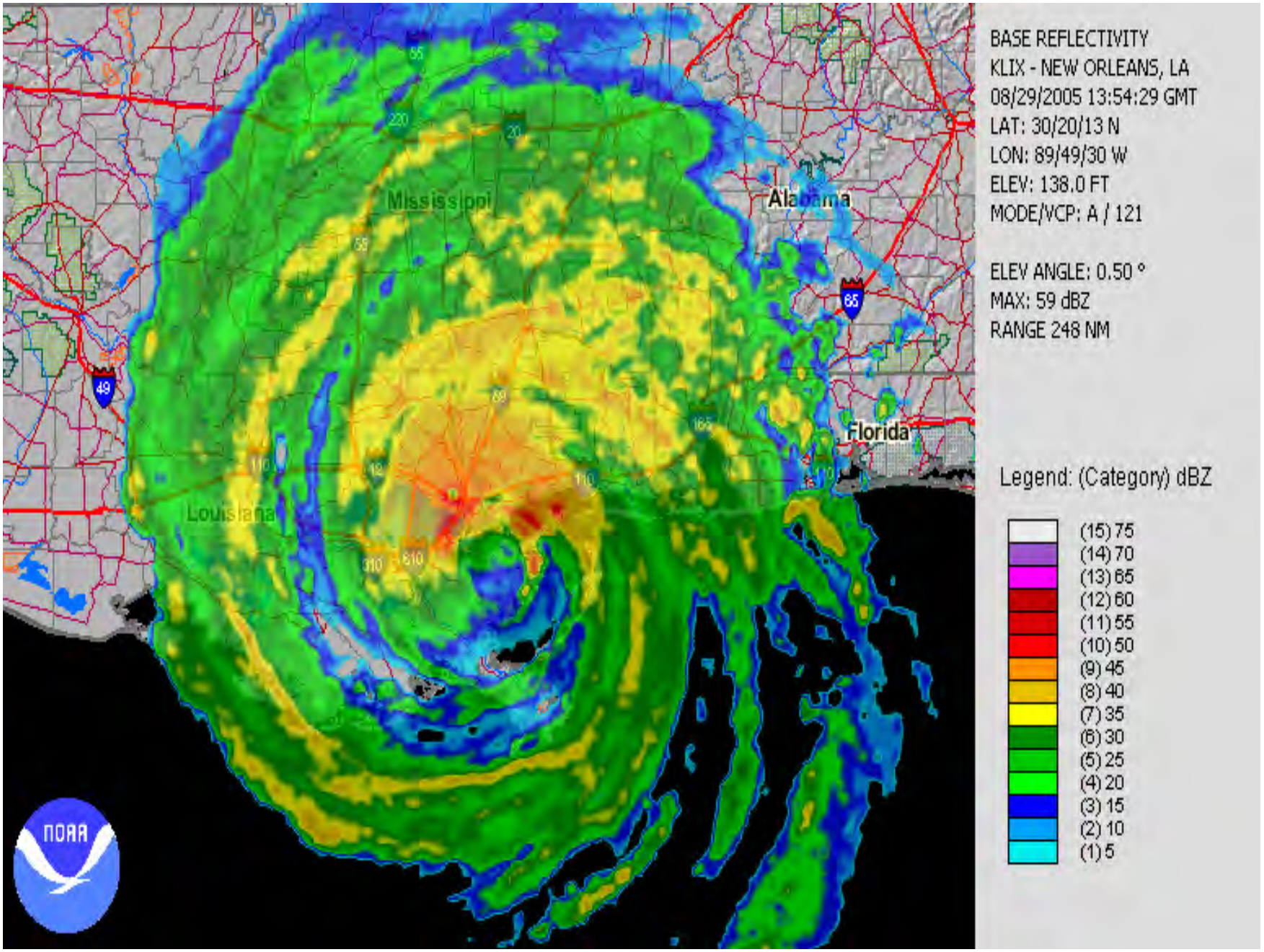
- New and more accurate technologies are useless without new and more accurate thinking.

- We know that many weather elements were not accurately measured in the 30s, 40s, 50s…all the way up to 2000; yet we continue to use this acknowledged, faulty data in research on hurricanes (and many other meteorological phenomena).

- We have NO reliable, consistent and accurate method of measuring various weather elements over open water, yet this is the area that produces the largest hurricanes.

The Need for Improvement

- Tropical Storm Alberto (1994), Tropical Storm Lee (2011) and others had slow development**, never** made hurricane status and flooded parts of the Southeast.
- Tropical storms/hurricanes with rapid development over open waters rarely maintain atmospheric support to stay at maximum strength. May weaken, then re-intensify.
- Tropical storms/hurricanes with rapid development within 300 miles of shore, mixed results.
- Over past 5 years, many tropical storms named with barely 39 mph winds.
- Another subjective measurement – winds reported by land stations use 2 minute wind speed average, but NHC uses 1 minute wind speed average to categorize hurricanes.
- No standardization of wind speed averaging times. Some agencies use 2 minutes, or 5, or 6, 10, 15 or whatever works best for their use of the data.


BASE REFLECTIVITY
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LON: 89/49/30 W
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MAX: 59 dBZ
RANGE 248 NM
Mississippi
Alabama
Florida
Louisiana
Legend: (Category) dBZ
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(14) 70
(13) 65
(12) 60
(11) 55
(10) 50
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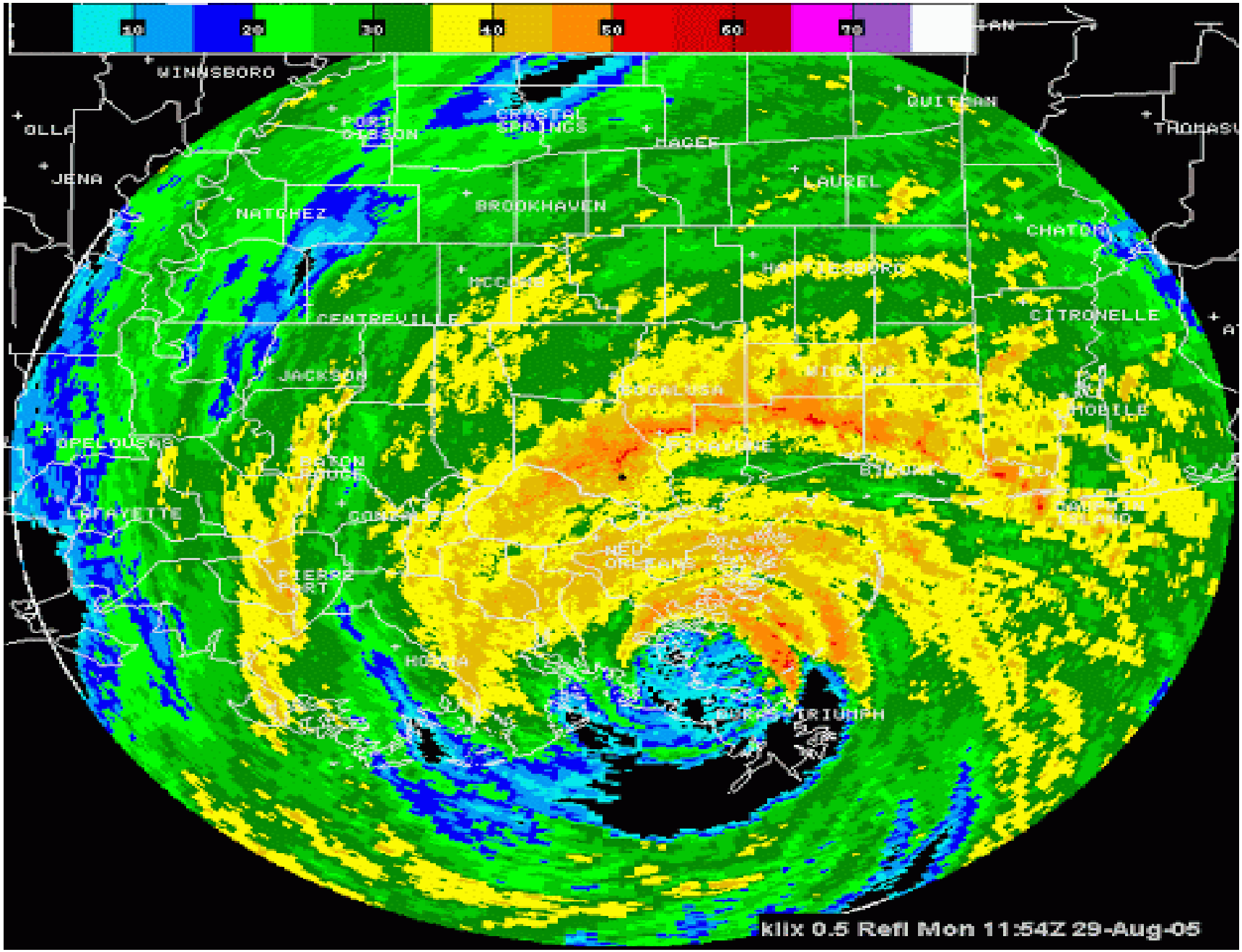
NOAA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LAFAYETTE
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Hurricane Damage Potential - Something Better

- **Hurricanes can cause catastrophic damage to coastlines and several hundred miles inland.**
- **Hurricanes can produce winds exceeding 155 miles per hour as well as tornadoes and microbursts. My work shows microbursts and small, tornadic vortices are more common that most people believe.**
- **Double eyewall (Katrina 2005) caused more damage than theoretically possible. Dr. Keith Blackwell, University of South Alabama, documented this phenomena.**
- **Additionally, hurricanes can create storm surges along the coast, but what came first, the wind or the water? Flying debris from the excessive winds are often the deadly and destructive results of these weather events.**
- **Although hurricane winds can exert tremendous pressure against homes, a large fraction of hurricane damage is not from the wind itself, but from airborne missiles such as tree limbs and branches, signs and sign posts, roof tiles, metal siding and other pieces of buildings, including entire roofs in major storms. John Hopkins University study – 1999**
- **This wind-borne debris penetrates doors and windows, and allows the force of the wind to act against interior walls and ceilings not designed to withstand such forces.**

Hurricane Damage Potential - Something Better

Hurricane Damage Potential - Something Better

Mr. Tim Marshall, on team of meteorologists and engineers that produced Enhanced Fujita Scale. Here are excerpts from Mr. Marshall concerning tornadoes and hurricanes:

* **Your home could be up to code, but your neighbor's house may not be**. This means flying debris originating elsewhere is a factor in tornado damages. This also applies to hurricanes.

* Wind speeds necessary to cause the observed damage to residences were found to be **significantly lower** than the established F-scale wind speeds.

* Tim Marshall talks about the limitations of weather radar, ("Imagine opening your eyes to see the storm but then closing them again for 6 minutes")

* John Hopkins University research (1999) noted that **an opening of only 5% of house can result in total destruction due to wind pressure.**

Hurricane Damage Potential - Something Better

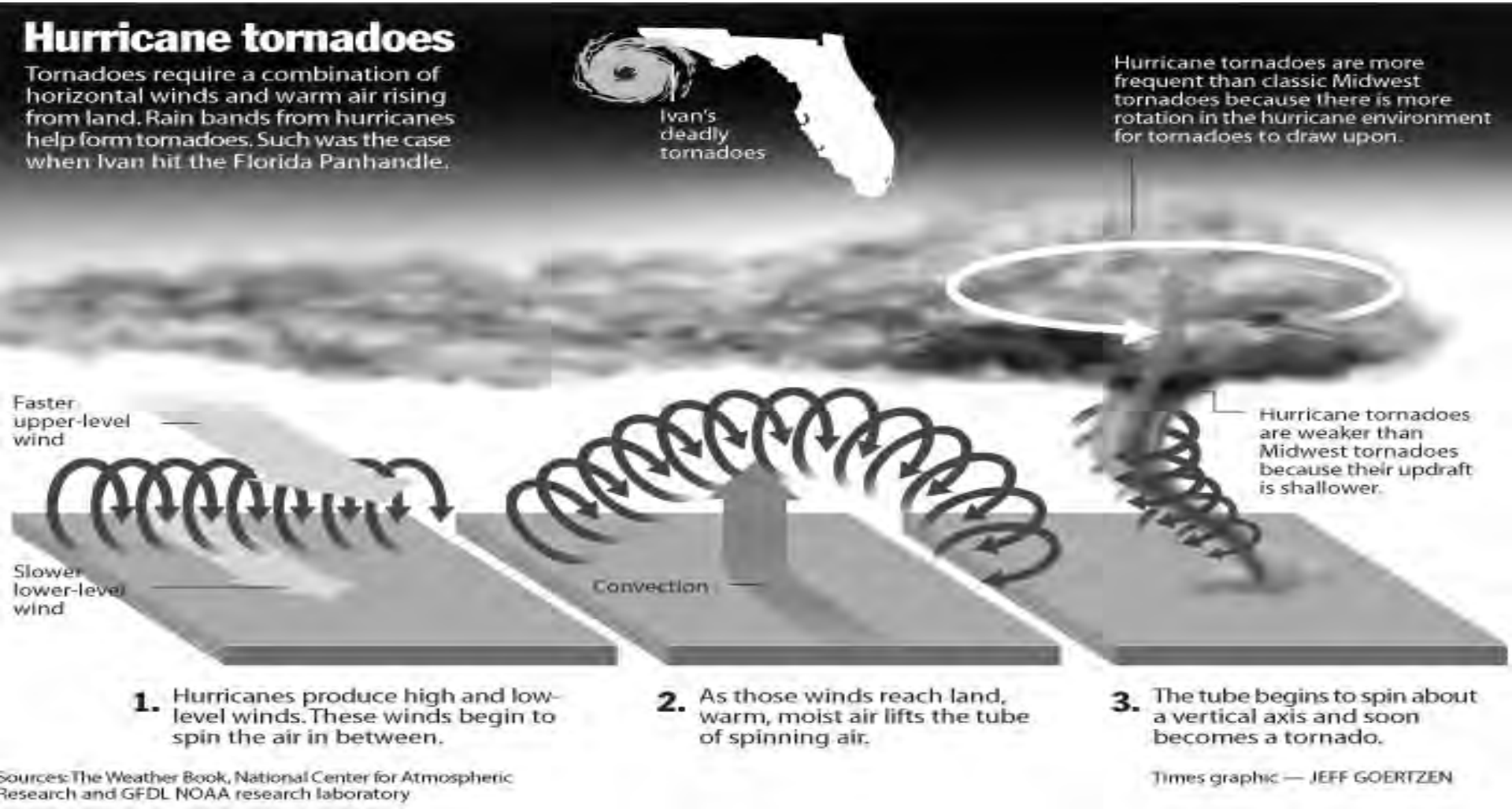
Hurricane Damage Potential - Something Better

Hurricane Damage Potential - Something Better

- Since use of NEXRAD, tornadoes found with every landfalling hurricane, since 1995, except Isaac and Sandy (2012).
- Most tornadoes associated with hurricanes are too small to be detected automatically by NEXRAD. Manual analysis is an absolute necessity.
- To be detected by NEXRAD, minimum diameter is 250 feet. Most tornadoes associated with hurricanes are much smaller in diameter.
- Tornadoes are not as large as typical tornadoes. Lower elevation and depth, as low as 2000 feet.
- Usually EF0, EF1, possible EF2…but what people tend to forget, these tornadoes are embedded in a hurricane wind field.
- Usually not seen due to short durations, as little as a few seconds, but can still destroy property.

Hurricane Damage Potential - Something Better

- **Hidden Dangers from Hurricanes**



Hurricane Damage Potential - Something Better

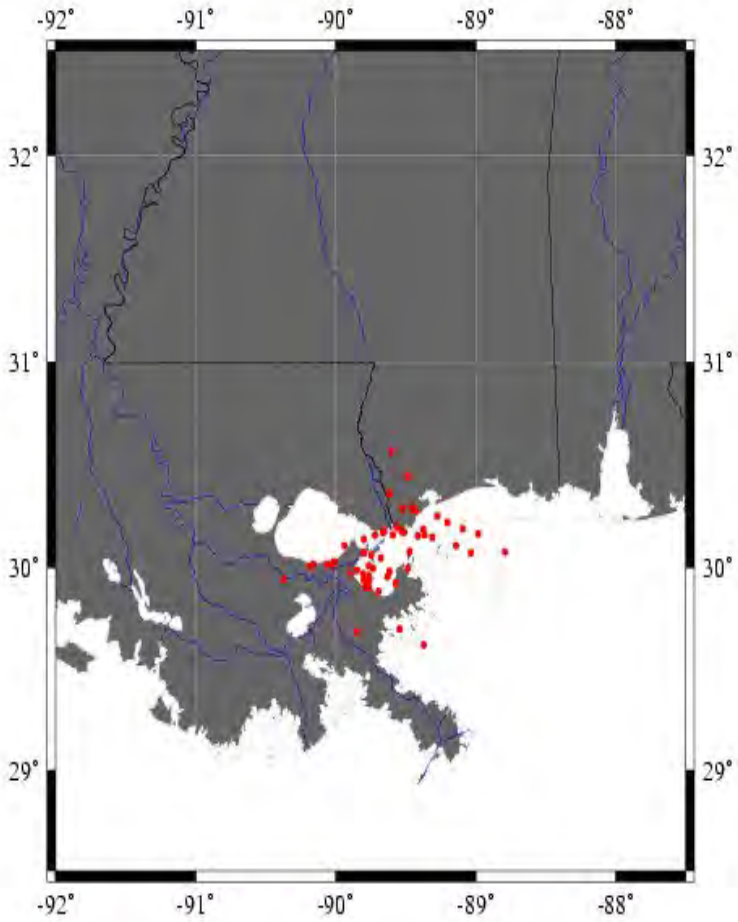
- Tornadoes (AMS)
  - Originally thought to form only in outer rain bands – WRONG! Studies have found tornadoes can form almost anywhere in hurricane.
  - Study of the hurricanes of the last 22 years reveals that nearly every tropical cyclone of full hurricane intensity whose center crosses the United States coast between Brownsville, Texas and Long Island, New York has associated tornadoes…thanks to NEXRAD.
  - Remember, a EF0 can destroy homes because they are embedded in hurricane wind field.

Tornado Watch # 755 - Valid from 1025 AM until 640 PM CDT

NOAA/NWS/Storm Prediction Center

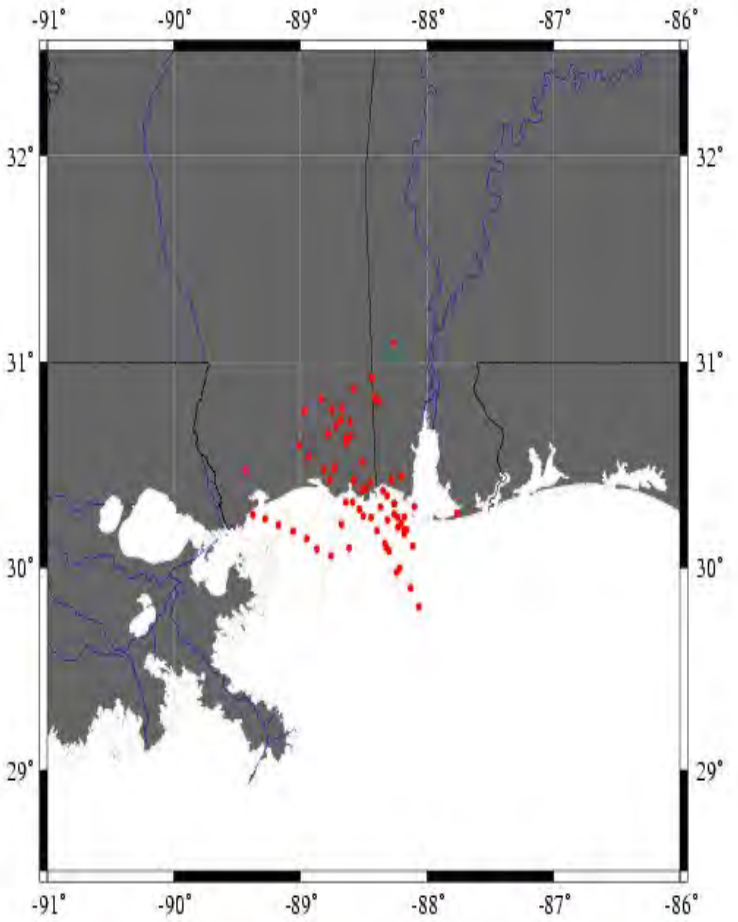
Updated: 20050830/0509 UTC

Possible_Tornadoes_Slidell_Radar



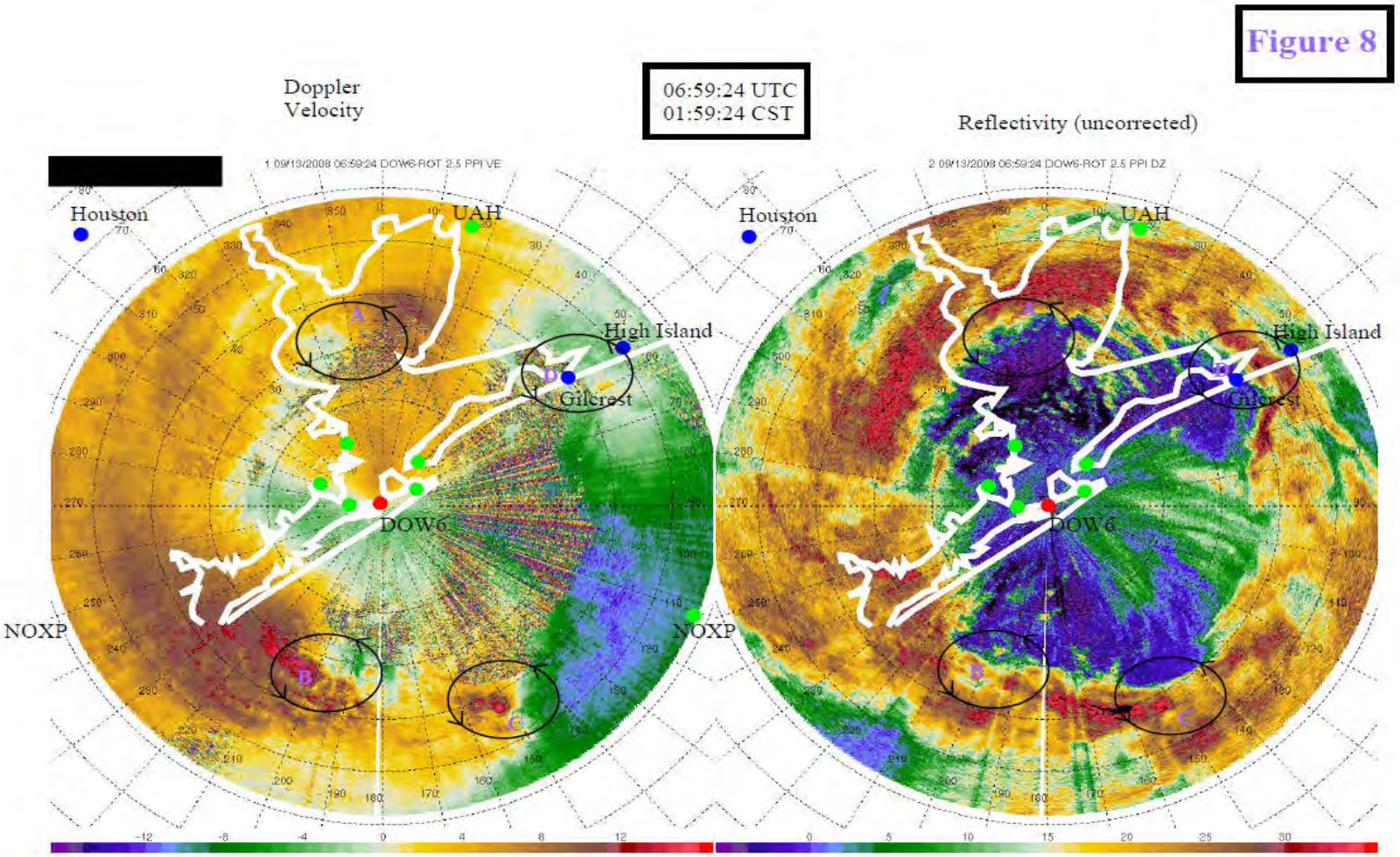
Possible tornadoes based on mesocyclone markers

Possible_Tornadoes_Mobile_Radar



Possible tornadoes based on mesocyclone markers

Hurricane Damage Potential - Something Better (CSWR)



Hurricane Damage Potential - Something Better

Microbursts

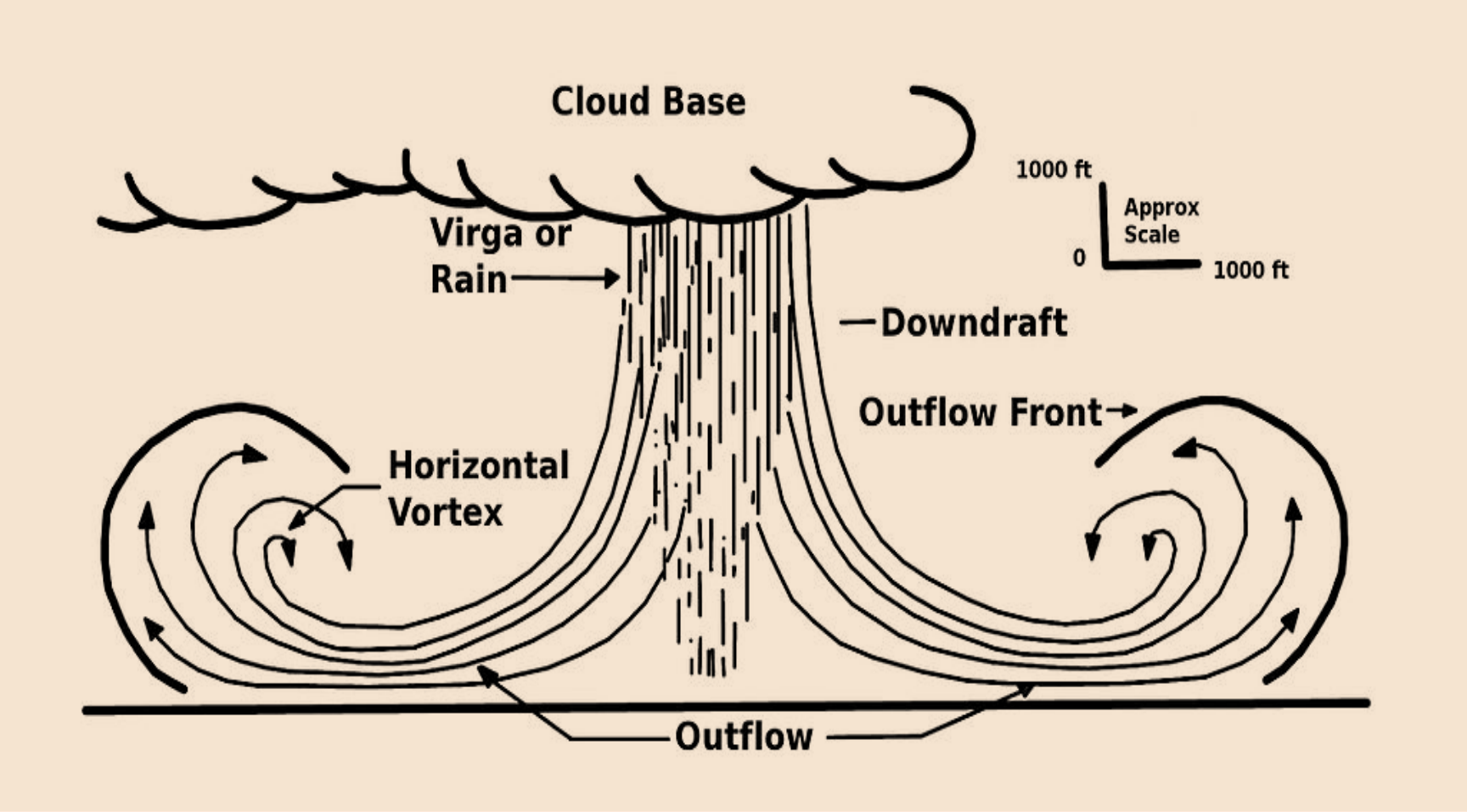
- Occurs when storm cell collapses; all cloud mass falls towards ground, generating tremendous wind speeds. At times, looks like bomb blast.
- Numerous gusts during hurricanes are the result of microbursts. Scores of microbursts during Katrina, Ivan and Ike.
- Manual analysis of NEXRAD radar data necessary to determine if microburst occurred.

Hurricane Damage Potential - Something Better

Microbursts

- With exception of Isaac and Sandy, I have found every hurricane since 1995 had microbursts occurring.
- Can only be detected through manual analysis of NEXRAD data.
- Helps to explain why entire neighborhoods are wiped out (Waveland, Pass Christian)

Hurricane Damage Potential - Something Better



Hurricane Damage Potential - Something Better

- **Gust factors**
  - **The gust factor is the difference between the "sustained" winds and the maximum gust. If the sustained winds are 50 miles per hour and the gusts equal 100 miles per hour, the gust factor is 2.0.**
  - **The gust factor is critical because it deals with the associated wind force.**
  - **Sustained winds are defined differently by the NWS and NHC. This is extremely critical because it is used in engineering evaluations.**
  - **NWS – sustained winds are the 2 minute wind speed average.**
  - **NHC – sustained winds are the 1 minute wind speed average.**

If sustained wind speed is an average, then there has to be a higher and lower wind speed measurement during the stated time period. This information is not easily available, and must be manually analyzed to make the proper determination.

Wind force is the amount of "energy" affecting every structure generated by the wind. If the wind speed doubles, the wind force *quadruples!!*

Sometimes it's not just the wind speed value, but the gust factor as well, that must be calculated.

– Confusion at It's Finest

- **Back to El Nino – in 1992, strong El Nino, also Hurricane Andrew.**
- **2004 – Hurricanes Charley, Frances, Ivan and Jeanne…moderate El Nino using AMS guidelines, but no El Nino using NWS or ESR criteria..**
- **Everyone seems to be looking for the one factor that will provide insight to hurricane forecast. No one wants to believe El Nino is part of a puzzle.**
- **Too many variables to use only one indicator with accuracy.**
- **Dr. Gray made controversial comments in 2008 about whether or not his forecasts had promoted hurricane forecast improvement.**
- **Arguments between scientists on whether or not "global warming" plays a part in hurricane forecasts. Dr. Gray doesn't believe in global warming theories, yet his partner, Dr. Phil Klotzbach, believes in global warming.**
- **A look at past years shows a wide range of variation in pre-seasonal values, indicating there is no real consensus between different agencies.**
- **Funding for hurricane research is drying up due to lack of inaccurate projections.**
- **In the past, hurricane predictions were issued in December, April, and August.**

Confusion at It's Finest

- **December 2011 – from Colorado State University*…We are discontinuing our early December quantitative hurricane forecast for the next year and giving a more qualitative discussion of the factors which will determine next year's Atlantic basin hurricane activity.***
- ***Our early December Atlantic basin seasonal hurricane forecasts of the last 20 years have not shown real-time forecast skill even though the hindcast studies on which they were based had considerable skill. Reasons for this unexpected lack of skill are discussed.***
- **Not just Dr. Gray has been inaccurate. Dr. Gray has the most visibility; therefore he is used as the "measuring stick" for hurricane predictions.**
- **Agencies in the United States, Great Britain, the Caribbean have been issuing hurricane projections for decades with the same results as CSU.**
- **Tropical Storm Risk, a British company, issued a 2014 seasonal forecast in December 2013 and has already revised their numbers downward…and the season hasn't started yet.**
- **Remember, pre-season projections are for Atlantic Basin hurricanes only, does not include Gulf of Mexico or Caribbean.**

Ending the Confusion

- Stop focusing on 1 or 2 “guides”, educate the public on all possibilities.

- Drop “Expected Damages” from the Saffir-Simpson Scale.
  - We have learned that this “guide” isn’t uniform and too subjective.
  - Use only wind speeds to identify category of hurricane.
  - Since its’ inception, other features of the scale have been dropped (i.e. Storm Surge, Pressure)
  - Continue use of basic categories since the public knows this scale.

Begin to determine all factors when warning the public about impending dangers.

Use real-time information for public access.

Ending the Confusion

- Establish a single wind speed guide for assessing damages after-the-fact.
  - Beaufort Wind Scale
  - Saffir-Simpson Scale
  - NWS High Wind Warning
  - Enhanced Fujita Scale
  - Engineering guidelines

Incorporate factors such as age of the structure, how many other extreme weather events affected structure in past, storm duration, gust factors, and flying debris.

Ending the Confusion

- *Hurricane Damage Potential*
  - Incorporate factors such as wind speeds, gust factors, movement of hurricane, forward speed of hurricane, and expected generic changes as hurricane makes landfall.
  - Algorithms initially based on engineering data, and supplement as new real-time assessments are made.
  - Provide time-phased damage potential areas.
  - Develop a new measuring stick for evaluating hurricane damages.

    Example: Based similar to Enhanced Fujita Scale, where 26 types of structures have ratings and damage expectations based upon lower and upper boundaries.

Ending the Confusion

- Example:
  - Establish categories for age and type of house
    - 0-10 yrs: A 11-25 yrs: B 25-40 yrs: C
    - Start with ASCE calculations – winds of XX will result in XX% of damage for Category A structures, XX% of damage to Category B structures and so on.
    - Determination based upon forecast wind speeds, forward movement and other factors.

Ending the Confusion

- Hurricane Damage Potential
  - It takes time and money for most of these changes, plus overcoming resistance to change.
  - Should be developed by only one agency or team.
  - Get media on board to educate the public.
  - Get Emergency Management support.
  - Funding from safety institutions and insurance companies to address all issues.

Landfall Forecast – 2014 (GWO)

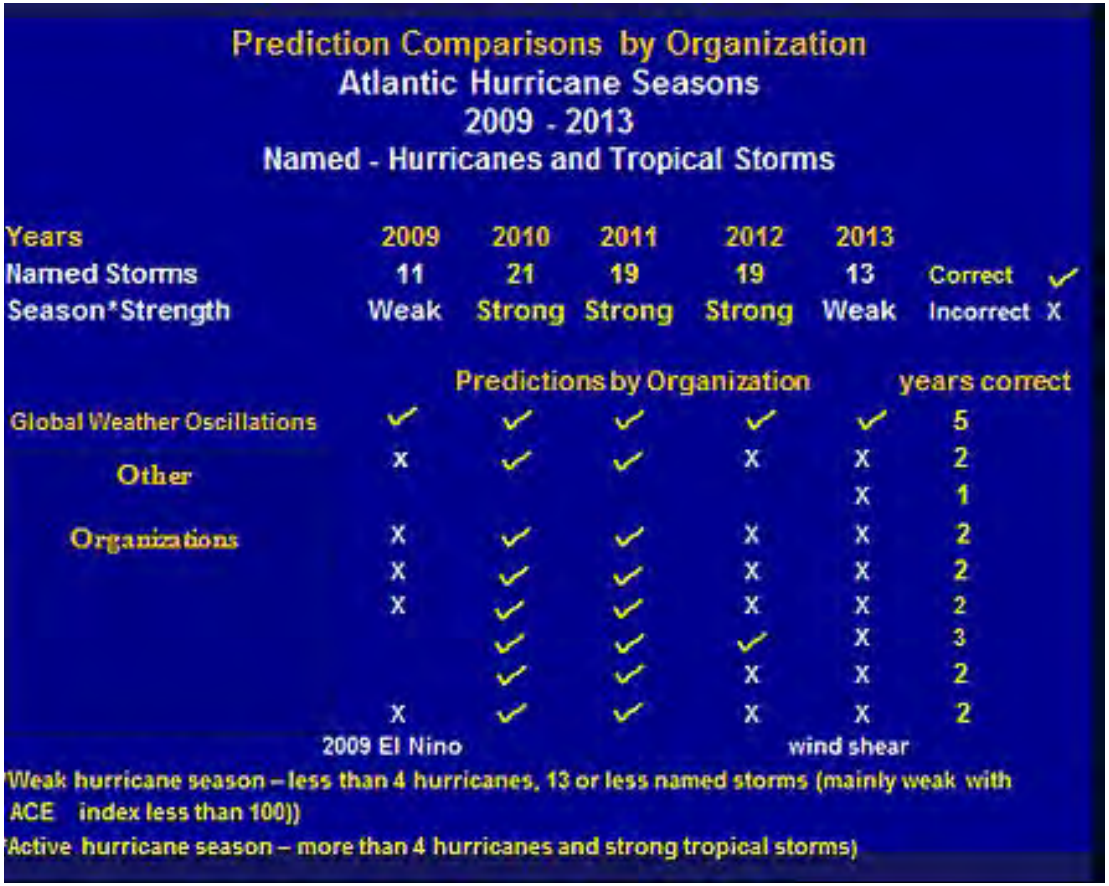
Landfall Forecast – 2014 (GWO)

2014 Predictions
Atlantic Hurricane Season
Named Tropical Cyclones (hurricanes and tropical storms)

	Named Storms	Hurricanes	Major Cat. 3-5
Long-Term Average	12	6	3
➢ *Global Weather Oscillations (GWO)	13	6	2
➢ Tropical Storm Risk	12	5	2
➢ Weather Channel	11	5	2
➢ WSI	11	5	2
➢ Impact Weather	10	3	1
➢ Weather Bell	8-10	3-5	1-2
➢ Colorado State	9	3	1

- *Global Weather Oscillations Inc. (GWO) expects active hurricane track cycles, and at least 2 hurricane landfalls, little or no influence for potential ElNino conditions
- *GWO is the only company with 11 prediction zones for hurricane conditions … and has a 90% hot zone prediction accuracy since 2006

Landfall Forecast – GWO 2006-2013



Prediction Comparisons by Organization
Atlantic Hurricane Seasons
2009 - 2013
Named - Hurricanes and Tropical Storms

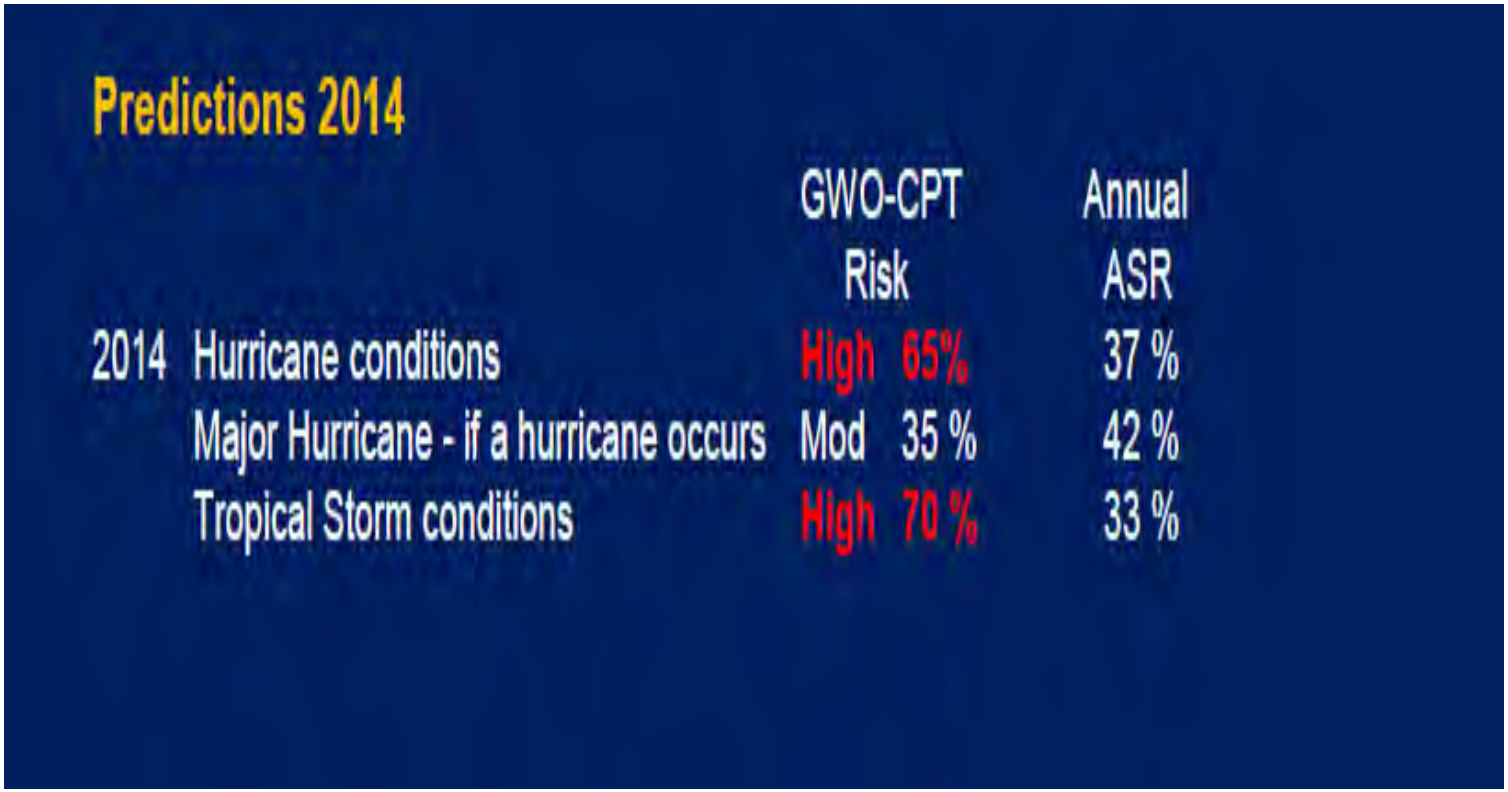
Years	2009	2010	2011	2012	2013	
Named Storms	11	21	19	19	13	Correct ✓
Season*Strength	Weak	Strong	Strong	Strong	Weak	Incorrect X

	Predictions by Organization					years correct
Global Weather Oscillations	✓	✓	✓	✓	✓	5
Other Organizations	X	✓	✓	X	X	2
					X	1
	X	✓	✓	X	X	2
	X	✓	✓	X	X	2
	X	✓	✓	X	X	2
		✓	✓	✓	X	3
		✓	✓	X	X	2
	X	✓	✓	X	X	2
	2009 El Nino				wind shear	

Weak hurricane season – less than 4 hurricanes, 13 or less named storms (mainly weak with ACE index less than 100))
Active hurricane season – more than 4 hurricanes and strong tropical storms)

Landfall Forecast – 2014 (GWO)

Zone 9 Houma Louisiana to Mexico Beach Florida



Landfall Forecast – 2014 (GWO)

Zone 9 Houma Louisiana to Mexico Beach Florida

- Zone 9 – High Risk (65%) hurricane in 2014, and possibly a tropical storm as well.
- GWO-CPT predicts a 35% chance of a major hurricane in 2014, if hurricane develops.

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